

Impacts of Humans on Ecosystems

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Introductions to Human Impacts

What I've Done - Linkin Park



<http://www.youtube.com/watch?v=L-ARX4kFdpk>

Take Action:

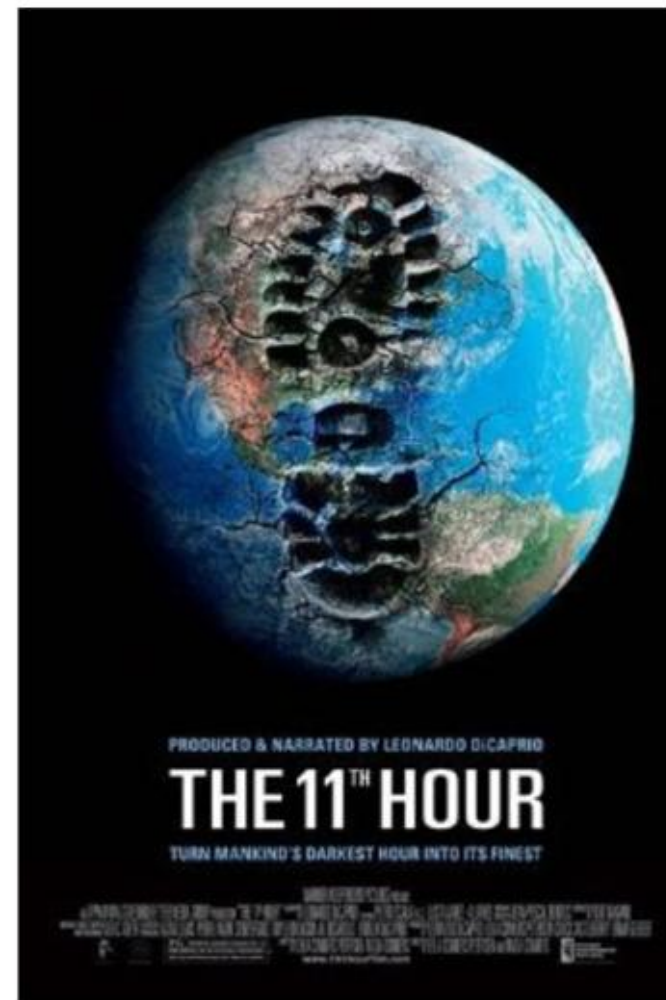


<http://www.worldwildlife.org/>



<http://11thhouraction.com/>

Watch the 11th Hour online:



<http://video.google.com/videoplay?docid=-2174195060267517042#>

Get more info and some questions here:

<http://wp.me/p7lr1-iz>

Simpson's Diversity Index is a measure of the diversity of a given area at a given time. It can be used to **compare two or more areas** or it can be used to **monitor one area over a period of time**.

$$D = \frac{N(N-1)}{\sum n(n-1)}$$

total number of individuals of all species
N(N-1)
Diversity
sum n(n-1)
number of individuals of each species

(a high value indicates high diversity)

Simpsons links:

<http://www.countrysideinfo.co.uk/simpsons.htm>

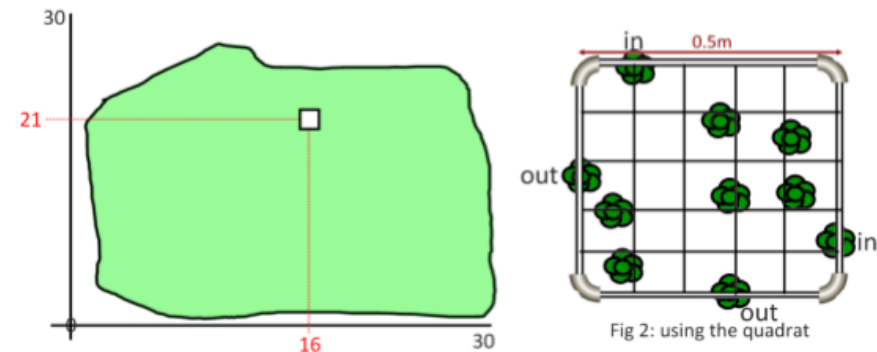
<http://rewhc.org/biomeasures.shtml>

Kick sampling can be used to collect invertebrates:



<http://www.microscopy-uk.org.uk/mag/art97b/stream.html>

Quadrats can be used to collect data on plant (or sessile) species:

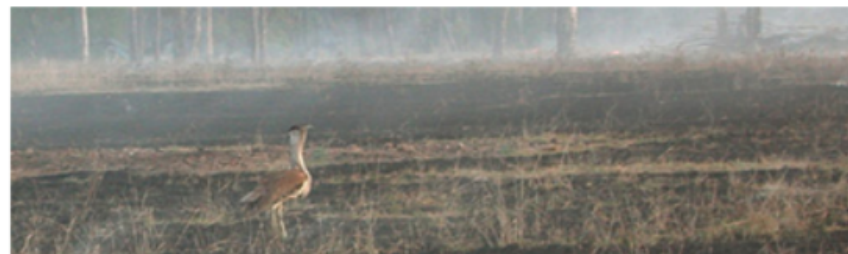


Simpson's Diversity Index in action:

Australian Aborigines improve biodiversity by starting fires.

The Martu tribe set fires to areas to reduce the dominance of spinifex grass and encourage the growth of other species.

They call this the 'fire-stick farming' hypothesis.



Post-fire land.

Work through this example based on these simplified data:

Immediately prior to burning			Immediately post-burning			Five years post-burning		
species	count (n)		species	count (n)		species	count (n)	
A	125		A	12		A	16	
B	21		B	1		B	45	
C	14		C	0		C	34	
D	8		D	0		D	95	
E	7		E	0		E	25	
F	5		F	0		F	36	
G	5		G	0		G	80	
H	5		H	3		H	101	

Original paper: <http://www.pnas.org/content/105/39/14796>

Great article:

http://scienceblogs.com/notrocketscience/2008/09/aborigines_improve_biodiversity_by_starting_fires.php

Not Exactly
Rocket Science
science for everyone

Calculating D is easy on Excel:
just set up the table in an easy-to-manage way

$$D = \frac{N(N-1)}{\sum n(n-1)}$$

Learn how to do this
with your GDC.

Immediately prior to burning		
species	count (n)	n(n-1)
A	125	15500
B	21	420
C	14	182
D	8	56
E	7	42
F	5	20
G	5	20
H	5	20
ΣN	=SUM(A to H)	
$\Sigma N(N-1)$	=((ΣN)*($\Sigma N-1$))	
	$\Sigma n(n-1)$ =SUM(n*n-1)	
D =	$\frac{\Sigma N(N-1)}{\Sigma n(n-1)}$	
D =		

Immediately prior to burning		
species	count (n)	n(n-1)
A	125	15500
B	21	420
C	14	182
D	8	56
E	7	42
F	5	20
G	5	20
H	5	20
ΣN	190	
$\Sigma N(N-1)$	35910	
	$\Sigma n(n-1)$	16260
D =	$\frac{\Sigma N(N-1)}{\Sigma n(n-1)}$	
D =	2.21	

Compare this to other data sets.

Processed data:

$$D = \frac{N(N-1)}{\sum n(n-1)}$$

Immediately prior to burning			Immediately post-burning			Five years post-burning		
species	count (n)	n(n-1)	species	count (n)	n(n-1)	species	count (n)	n(n-1)
A	125	15500	A	12	132	A	16	240
B	21	420	B	1	0	B	45	1980
C	14	182	C	0	0	C	34	1122
D	8	56	D	0	0	D	95	8930
E	7	42	E	0	0	E	25	600
F	5	20	F	0	0	F	36	1260
G	5	20	G	0	0	G	80	6320
H	5	20	H	3	6	H	101	10100
ΣN	190		ΣN	16		ΣN	432	
ΣN(N-1)	35910		ΣN(N-1)	240		ΣN(N-1)	186192	
	Σn(n-1)	16260		Σn(n-1)	138		Σn(n-1)	30552
D =	ΣN(N-1)		D =	ΣN(N-1)		D =	ΣN(N-1)	
	Σn(n-1)			Σn(n-1)			Σn(n-1)	
D =	2.21		D =	1.74		D =	6.09	

1. What has happened to diversity 5 years after burning?

2. From the results, deduce which species is *spinifex*.

3. What type of succession is modeled here?

Processed data:

$$D = \frac{N(N-1)}{\sum n(n-1)}$$

Immediately prior to burning			Immediately post-burning			Five years post-burning		
species	count (n)	n(n-1)	species	count (n)	n(n-1)	species	count (n)	n(n-1)
A	125	15500	A	12	132	A	16	240
B	21	420	B	1	0	B	45	1980
C	14	182	C	0	0	C	34	1122
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ΣN	190		ΣN	16		ΣN	432	
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	Σn(n-1)	16260		Σn(n-1)	138		Σn(n-1)	30552
D =	ΣN(N-1)		D =	ΣN(N-1)		D =	ΣN(N-1)	
	Σn(n-1)			Σn(n-1)			Σn(n-1)	
D =	2.21		D =	1.74		D =	6.09	

1. What has happened to diversity 5 years after burning?

Diversity has increased. Before the fire, it was dominated by a few species. 5-years post-fire, there is greater species-richness, as evidenced by a much greater value for D.

2. From the results, deduce which species is *spinifex*.

Species A is the dominant *spinifex*.

3. What type of succession is modeled here?

Secondary succession.

Analysing data:

Simpson's Diversity Index can be a measure of:

$$D = \frac{N(N-1)}{\sum n(n-1)}$$

1. Species richness

(The higher the score, the greater the diversity - a good measure of the health of a habitat)

2. Dominance

(The lower the score, the more the area is dominated by one species or the area is under environmental stress)

3. Stability

(Consistent scores over a period of time suggest a stable local environment)

So why is this useful?

- Assess the health of a habitat or area over time
- Assess whether an area is stable or changing over time
- Can be used for any species, plant or animal
- Track invasive or dominant species over time
- Compare areas being treated in different ways
(e.g. cultivated vs wild land)
- Provides valuable data for policy makers and the public

Note:

The equation used here is actually Simpson's Reciprocal* Index.
In other sources, you may find the calculation for D as:

$$D = \frac{N(N-1)}{\sum n(n-1)}$$

$$D = \frac{\sum n(n-1)}{N(N-1)}$$

Positions reversed, giving a maximum score of 1.
In this case, the closer the score is to 1, the more the area is dominated by a single species.

*this means 1/D.

To find out more about using Simpson's Diversity Index, try these sources:

<http://www.countrysideinfo.co.uk/simpsons.htm>

<http://rewhc.org/biomeasures.shtml>

Why conserve the rainforests?

Palm-oil cost to Borneo



<http://www.youtube.com/watch?v=YHki3EgGzdY>

When discussing conservation and decision-making in science, it is also essential to ask the question:

"Who or what are stakeholders in this decision and how will it affect them?"

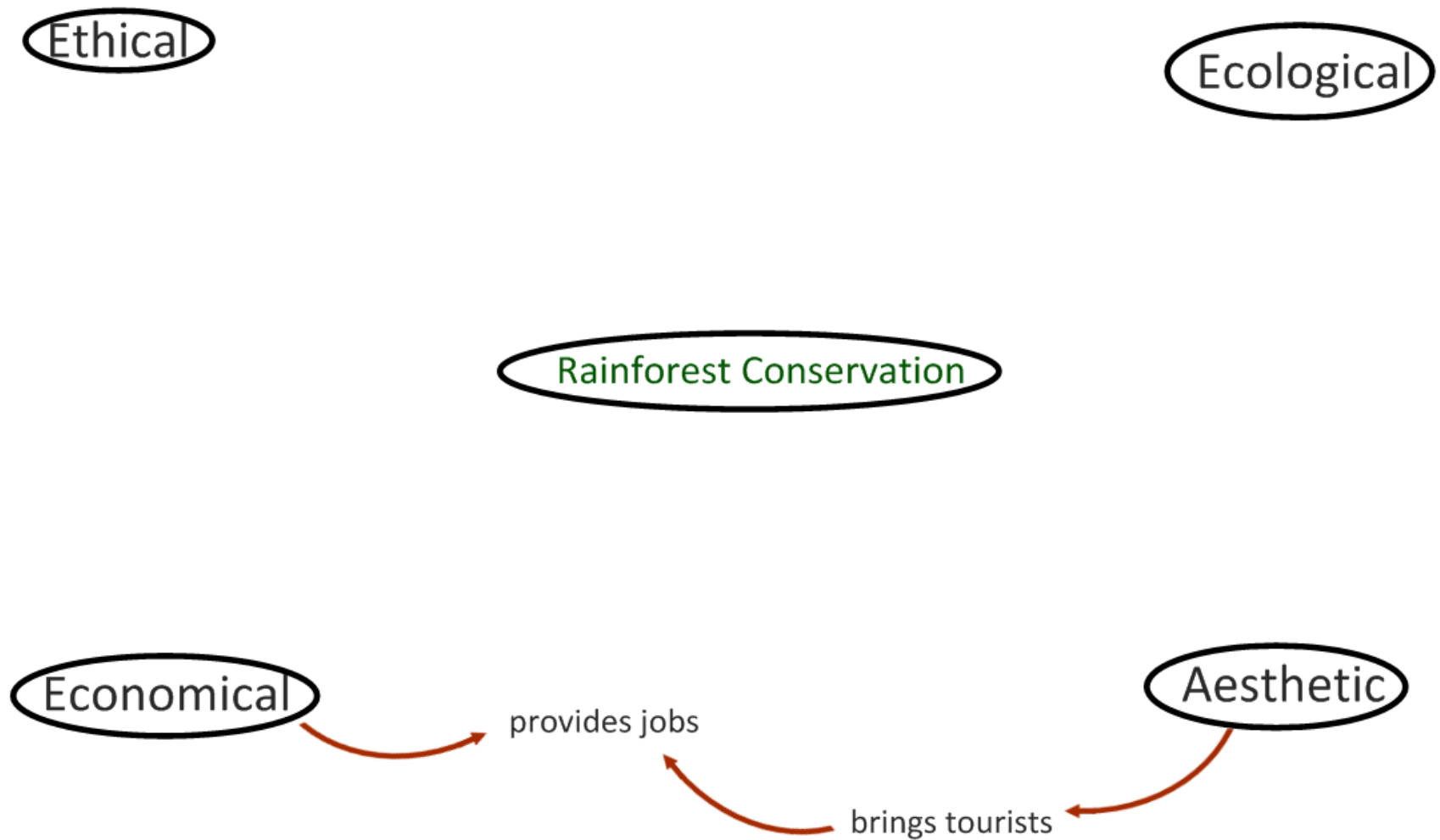
Reasons for conservation of any habitat are many, but we can look at the question in terms of four main areas of concern:

1. Ecological
2. Ethical
3. Economical
4. Aesthetic

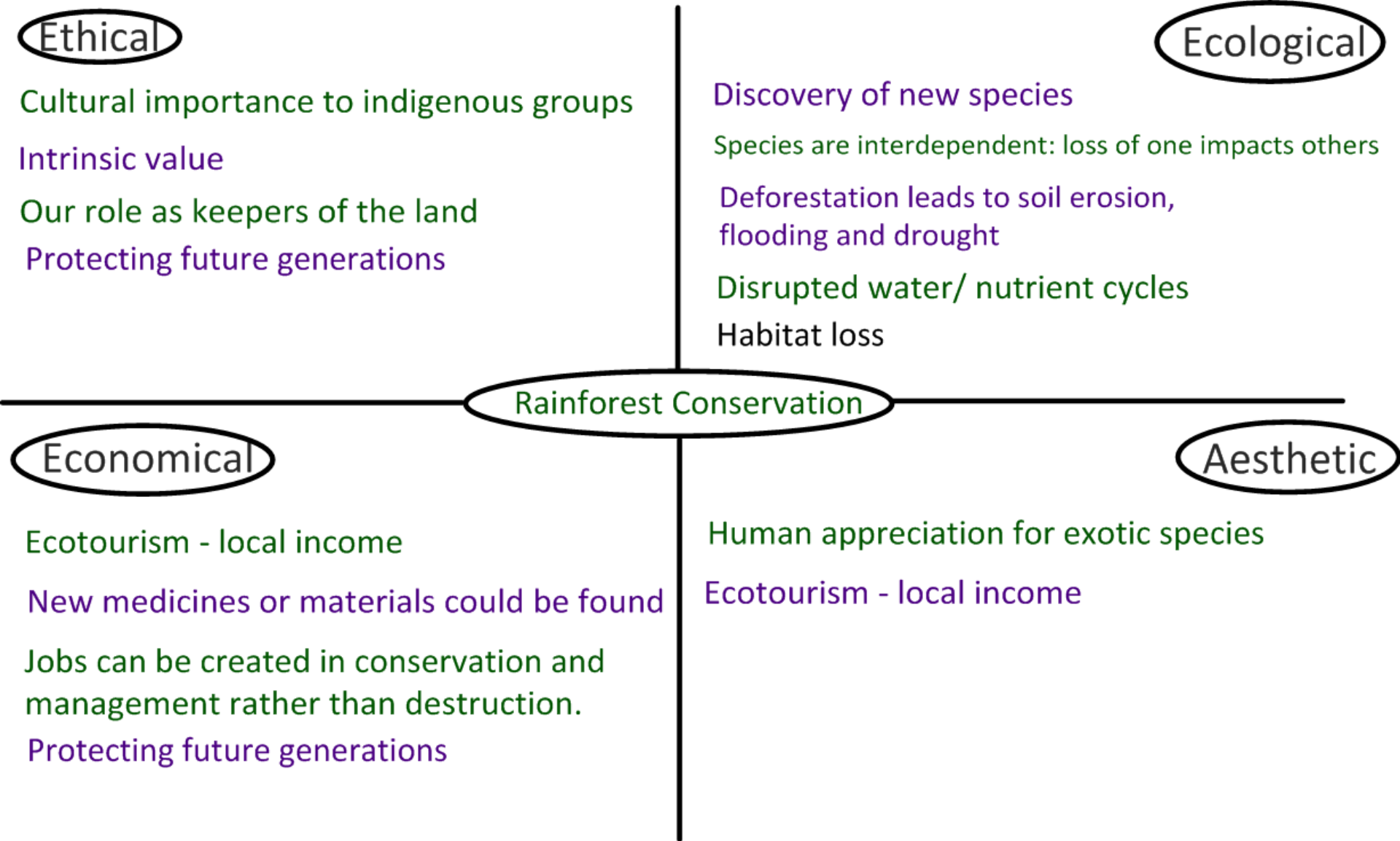


<http://www.youtube.com/watch?v=M2Cqo1Aksv4>

Complete this mind-map of reasons to conserve the rainforest:



Considerations in conservation of the rainforests:



Inspirational Rainforest Conservation:

Read it here:

<http://www.guardian.co.uk/environment/2008/may/04/conservation.wildlife>

How does the project work?

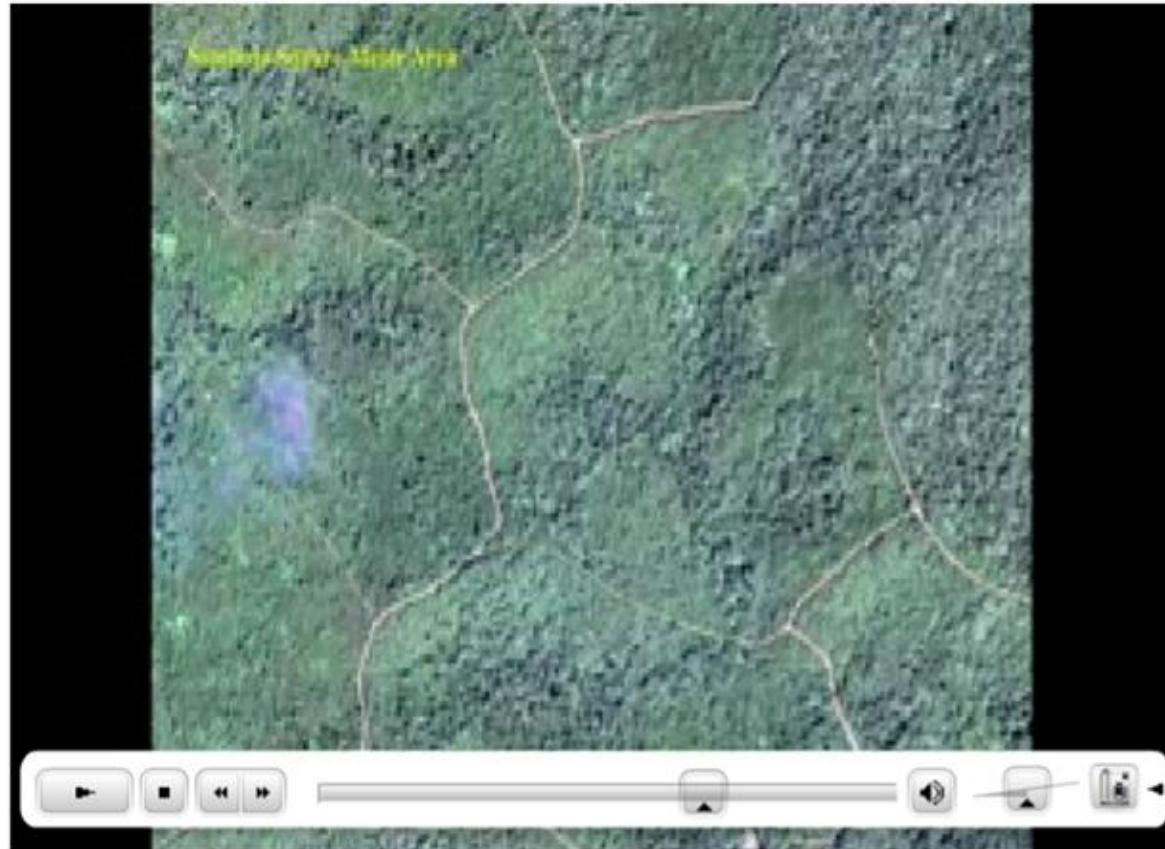
How have they considered all of the stakeholders in order to ensure success of the project?

How is it economically viable?

What is likely to have happened to Simpson's Diversity Index of the area over time?

Could this idea be used elsewhere?

How we re-grew a rainforest, by Willie Smits



http://blog.ted.com/2009/03/a_20year_tale_o.php

Alien Species

An **alien species** is one which arrives in a **non-native habitat**, usually as the intentional or accidental result of human activity.

Often, an alien species is not well adapted to this habitat and will not survive - it is too far outside its **niche**.

However, there are many examples of alien species which have been successful in their new habitat. Some of these have been very **invasive** and causes ecological and economical damage.

Examples:

Zebra mussels (originally from Russia) were **accidentally released** by ballast water from ships and now dominate waterways worldwide.

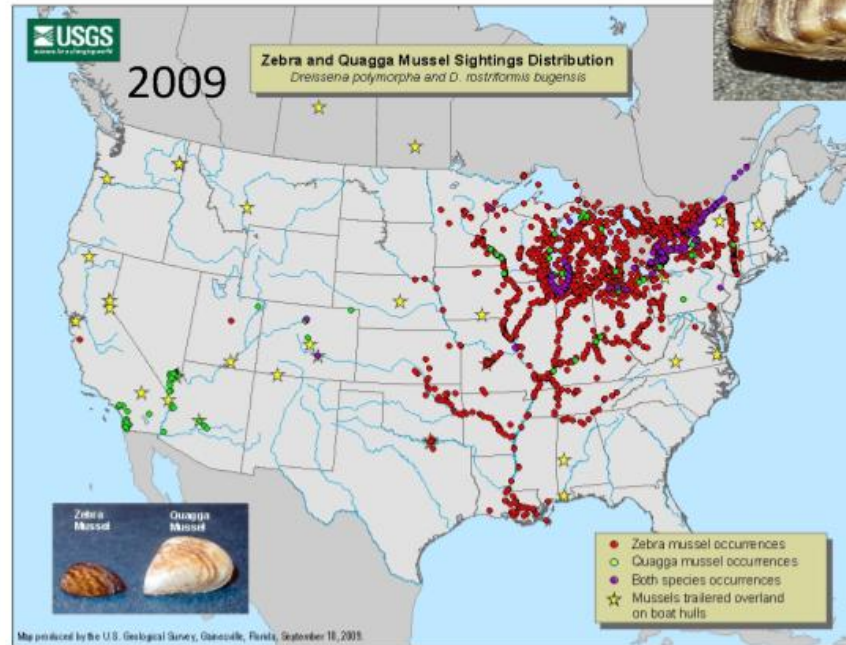
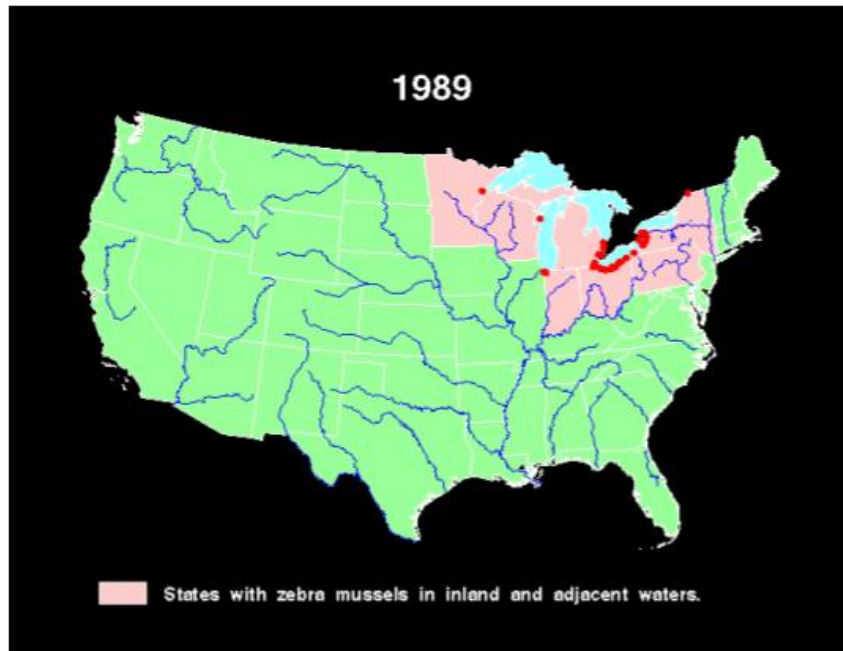
Japanese knotweed is a nutritious plant, though following its **import (intentional)** has been classified as invasive and a threat to other species.

The **cane toad** was **introduced to Australia** and other parts of the world **to control agricultural crop pests**. It is now classed as an invasive species as it has reproduced so heavily and its toxic skin is a threat to other animals and predators.



not these aliens!

Alien invasion example: Zebra mussel invasion



<http://nas.er.usgs.gov/taxgroup/mollusks/zebramussel/>

Red dots represent sightings

Dreissena polymorpha is native to Russia. It was transported to the USA and other countries in the ballast water of tankers. When the tankers emptied this water in ports, they delivered the zebra mussels to new waterways. It grows so prolifically that it blocks drains, sewers and water supplies and has caused millions of dollars of damage.

Zebra mussels on a pipe:

<http://www.wwpatenaude.com/wzmussel.htm>



Cane Toads: Introduced on purpose, Invasive by accident

Australian campaign animation



<http://www.youtube.com/watch?v=t3ENUqV5-bw>

Australians are encouraged to kill cane toads when they see them, by putting them in a bag in the freezer.

Under development are **biological control** mechanisms based on **viruses and parasites** specific to the cane toad.

Source:

<http://www.issg.org/database/species/ecology.asp?si=113&fr=1&sts=sss&lang=EN>

The **cane toad** (*Bufo marinus*) was **introduced to Australia** and other parts of the world **to control agricultural crop pests** on sugar cane.

It is now classed as an **invasive species** as it has **reproduced so heavily** and its **toxic secretion and skin** is a threat to other animals and predators, as well as humans that come in contact.

They are very large (up to 1kg) and will try to eat "almost any terrestrial animal".

Operation 'Toad Day Out':



<http://www.youtube.com/watch?v=gX1FLXEo96g>

GLOBAL INVASIVE SPECIES DATABASE

Using the Global Invasive Species Database

<http://www.issg.org/database/welcome/>



Use the database to build a factsheet on one invasive species, either from your own country or found locally.

Find out information about:

- Binomial and common names and taxonomy
- Native and introduced geographical ranges
- Introduction pathways or vectors
- Local dispersal methods
- Impacts
- Management strategies
- Images

Japanese knotweed example:



<http://www.issg.org/database/species/ecology.asp?si=91&fr=1&sts=sss&lang=EN>



Impacts of invasive species:

Factor	Effect	Examples
inter-specific competition	'aliens' outcompete native species for resources, such as food, space or light. Native species may be forced out of their niches.	zebra mussels, <i>Caulerpa taxifolia</i>
predation	'aliens' are predators of other native species. Prey species numbers decline rapidly as they cannot adapt to the new predator.	cane toads
species extinction	in some cases, extinction occurs due to hybridization - 'pollution' of the native species gene pool. a new species is formed replacing the native one.	rainbow trout ruddy duck
biological control	an advantage - invaders can control the population of another invasive species from the same origin.	south american moth controls american prickly pear cactus which has invaded Australia

Find out more:
 <http://www.actionbioscience.org/biodiversity/simberloff.html>

Invasive species database:
 <http://www.issg.org/database/welcome/>

Biological control of invasive species

This is the use or introduction of one organism to control another invasive species.

Example:

RHDV (rabbit haemorrhagic disease virus) has been introduced to Australia in order to control the population of rabbits.

Problem:

Rabbits introduced and population exploded. Widespread damage to crops and interspecific competition with local species.

Solution:

Introduce RHDV, a virus specific to the rabbits.

Tested under quarantine first (to ensure safety), then released into wild populations.

Adult rabbit contact spreads the virus, but it does not affect any other species.

Effectiveness:

Very effective, though some evidence of RHDV resistance in rabbits is starting to become apparent.



Image: 'Please take note'

www.flickr.com/photos/14573979@N00/380078404

Read this example of a project to control the invasive Siam weed in Indonesia:

<http://www.aciar.gov.au/project/CS2/1991/010>



Australian Government

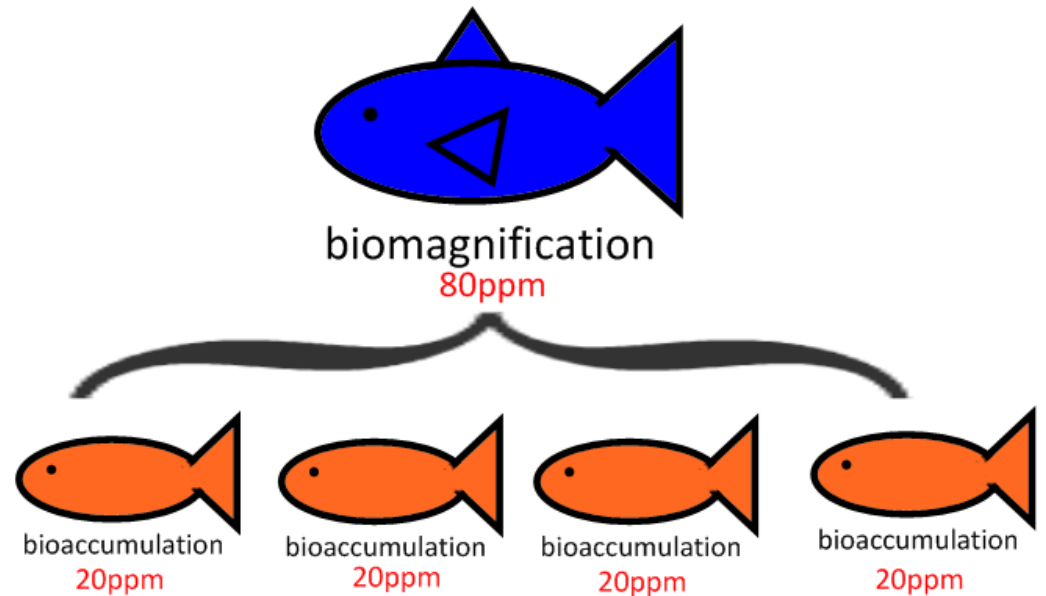
Australian Centre for
International Agricultural Research

Biomagnification

a process in which chemical substances become more concentrated at each trophic level.

DDT, dioxins, pesticides, TBT and mercury are all examples of highly toxic chemicals that are biomagnified.

WWF's biomagnification message:



As each individual eats contaminated food or filters contaminated water, it is building up these chemical substances. This is known as **bioaccumulation**. Bioaccumulation occurs **within one trophic level**.

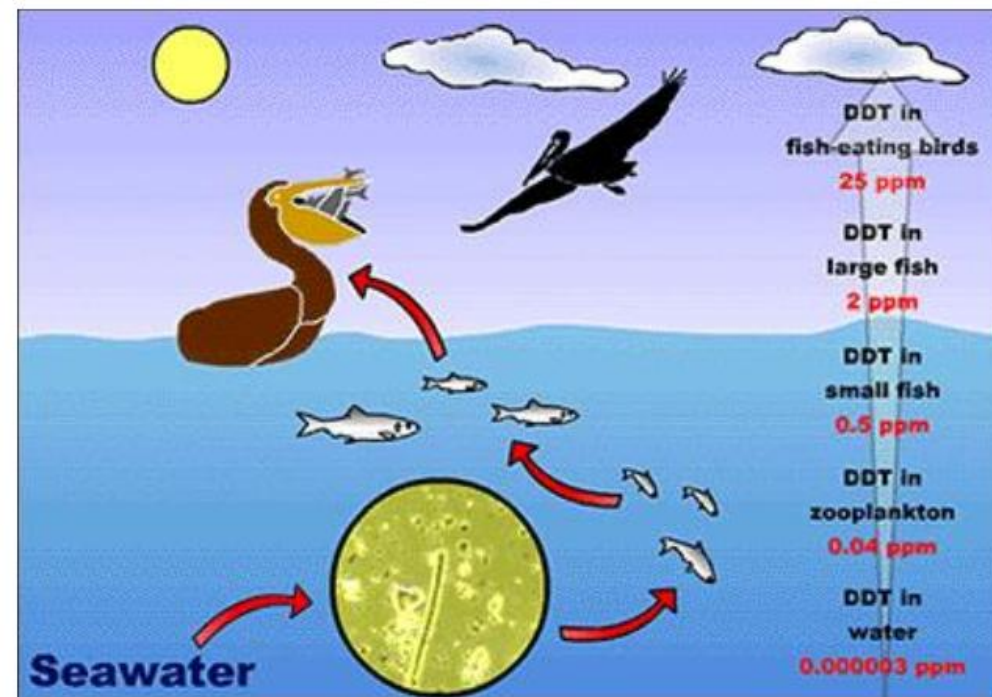
When a large number of contaminated individuals are eaten, they pass on a high concentration of chemicals to the predator. This **increase in concentration up the trophic levels** is **biomagnification**.

Biomagnification of DDT

Cause: DDT is a synthetic pesticide sprayed on crops and can be used against malaria mosquitoes.

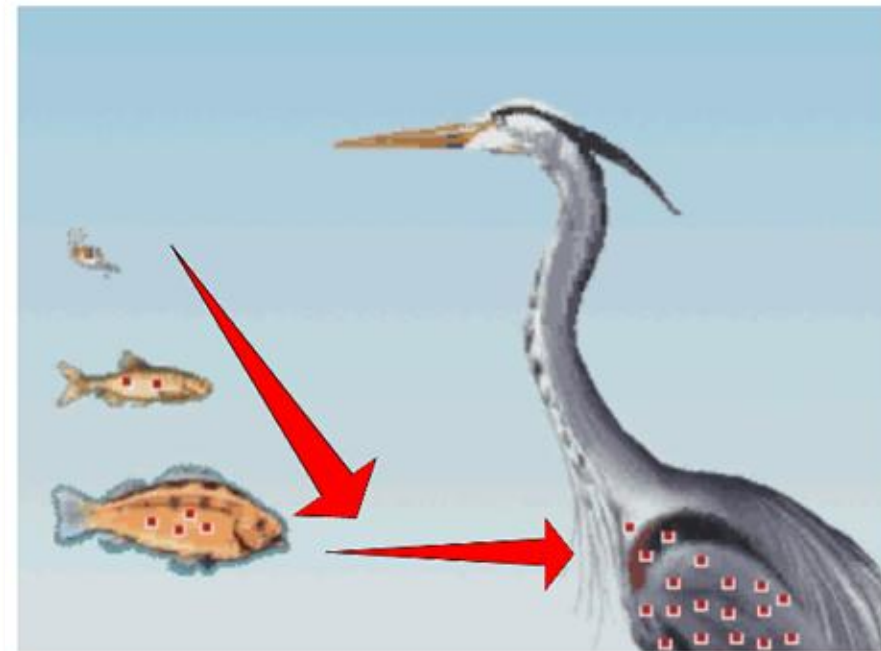
It is washed into waterways in low concentrations, where it is biomagnified up the food chain.

It is highly toxic at high concentrations.



BIOMAGNIFICATION OF DDT

http://www.eoearth.org/article/AP_Environmental_Science_Chapter_18-_Human_Health



<http://www.mhhe.com/biosci/pae/environmentalscience/enger8e/animations/bioaccumulation.mov>

Consequences:

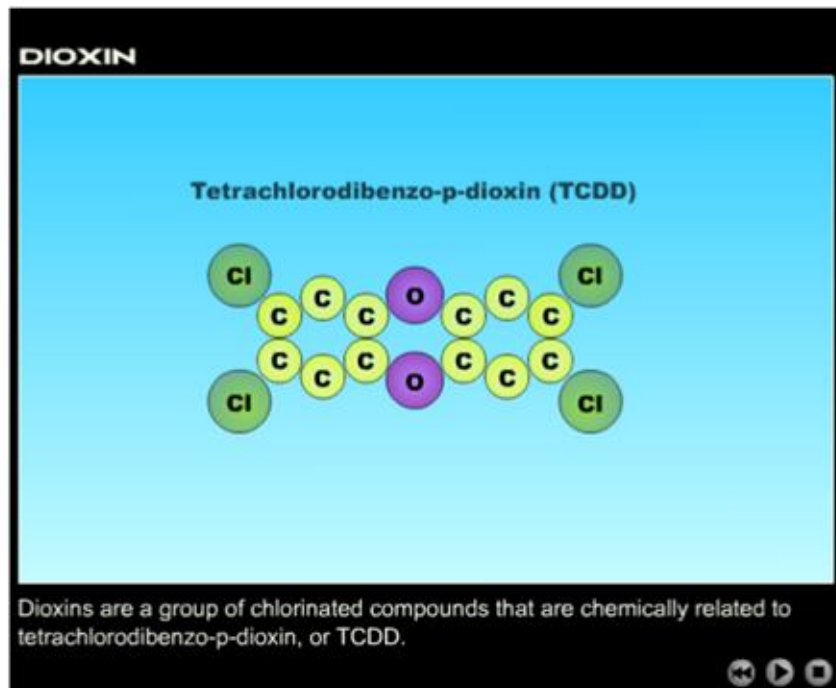
Stored in fats and accumulates quickly.

Very high concentrations in large fish and seabirds. It is responsible for reduced reproductive function and shell thinning in birds, which has impacted populations of large birds of prey (e.g. bald eagle or osprey) heavily.

In humans, it has been linked with cancers, fertility and developmental problems in humans.

Research other sources of biomagnification

Dioxins



http://www.ucopenaccess.org/courses/APEnvSciv2/course%20files/multimedia/lesson85/animations/5c_Dioxin.html

Heavy metals

macromedia FLASHPAPER

57% 1 / 40

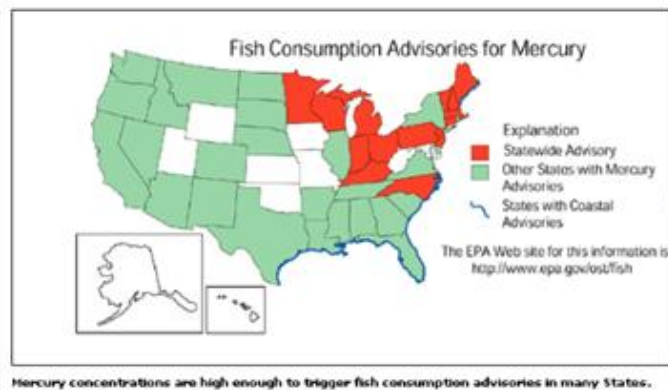
Water Quality Studies on the Great Salt Lake, Utah

Developing a Selenium Standard

Steering Committee Meeting
August 21, 2006.

William O. Moellmer, Ph.D.
Utah Division of Water Quality
Jeff DenBleyker
CH2M Hill

http://www.deq.utah.gov/Issues/GSL_WQSC/docs/STG_COM_082206.swf



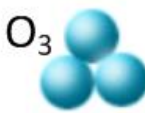
Mercury in fish stocks

<http://www.usgs.gov/themes/factsheet/146-00/>

TBT on ship hulls



Ozone (O_3) in the stratosphere absorbs UV radiation.



The high concentration of ozone (O_3) in this layer **absorbs over 93% of all UV radiation** which reaches Earth.

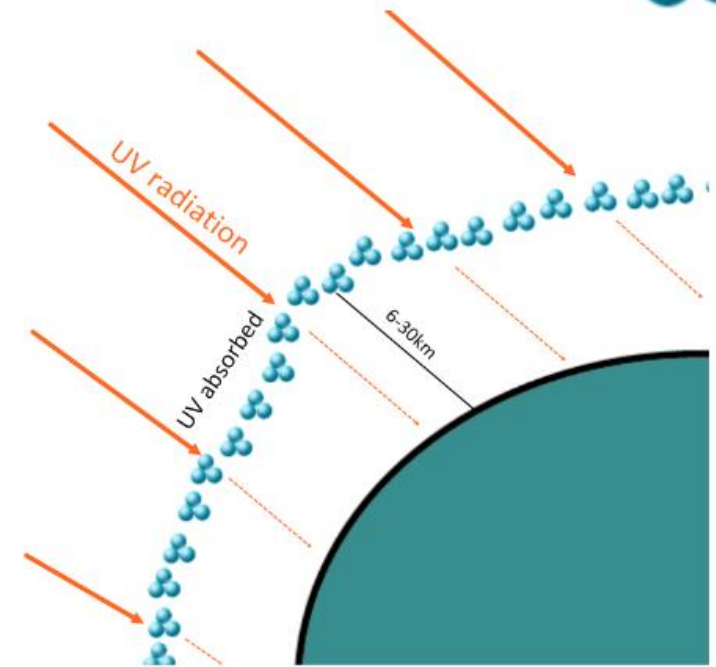
The ozone can be **depleted by chemical gases, including CFC's** (chlorofluorocarbons). These aggregate over polar regions and the cold temperatures allow for the depletion of the ozone layer by splitting CFC molecules, using UV.

The result is more harmful UV radiation reaching the Earth's surface, where it can cause damage to living things and contribute to global warming.

NASA explanation:



<http://www.youtube.com/watch?v=qUfVMogIdr8>

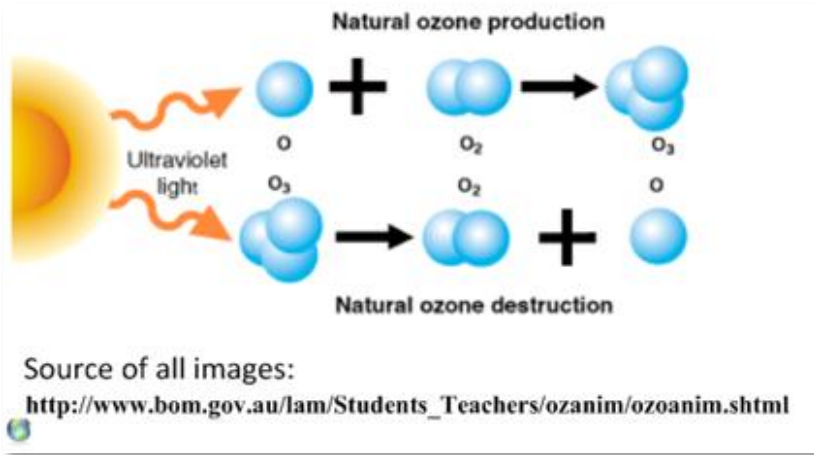


Ozone layer shielding the planet:



<http://svs.gsfc.nasa.gov/vis/a000000/a000800/a00834/index.html>

CFC's deplete the ozone layer



There is a natural balance of ozone creation and destruction due to UV radiation in the atmosphere. The ozone layer is maintained at safe levels.

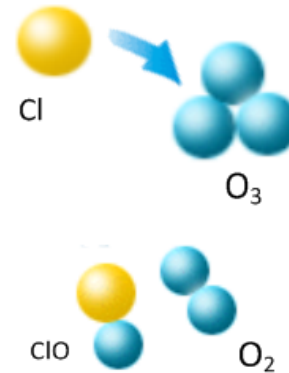
When CFC's are released into the atmosphere, they speed the depletion of the ozone layer.



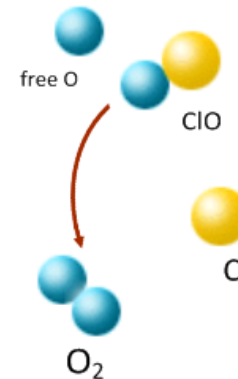
1. UV radiation splits CFC molecules.



2. This releases chlorine molecules.



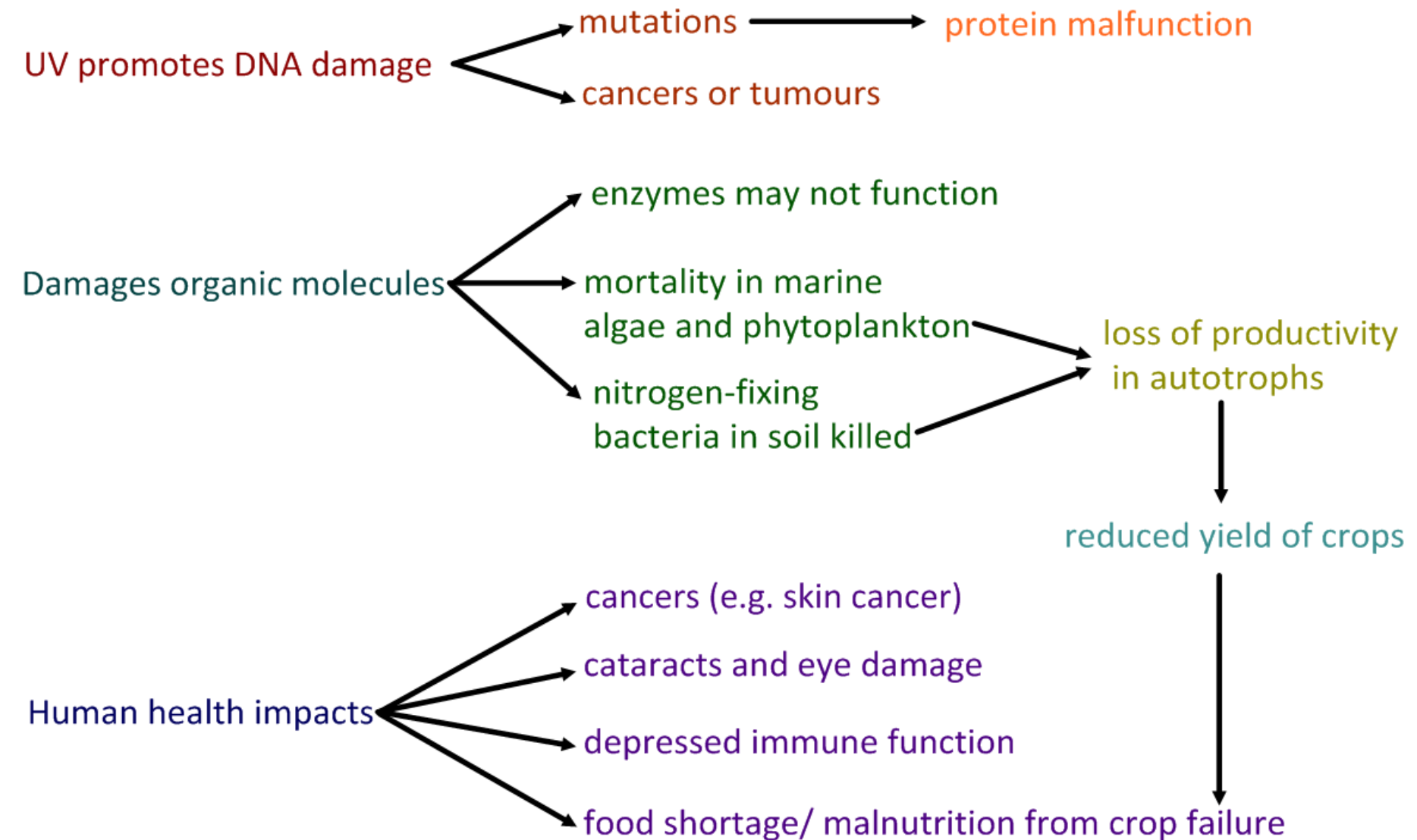
3. Chlorine splits ozone molecules into O₂ and ClO (chlorine monoxide).



4. Chlorine then binds free oxygen atoms and is released.

5. Chlorine goes on to split more ozone molecules. It can split up to 100,000 molecules. At that rate, natural ozone production cannot compensate.

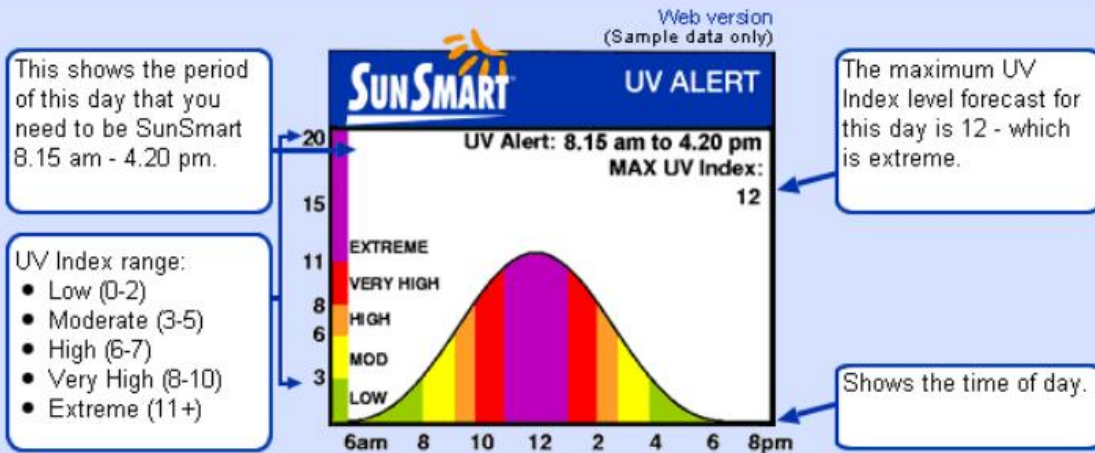
Elevated levels of UV are harmful to living organisms and biological productivity.



Stay safe in the sun!

Check the UV Alerts (if they exist) for your area.

How to read the UV Alert



From:



Protect yourself from harmful UV radiation.

UV Index

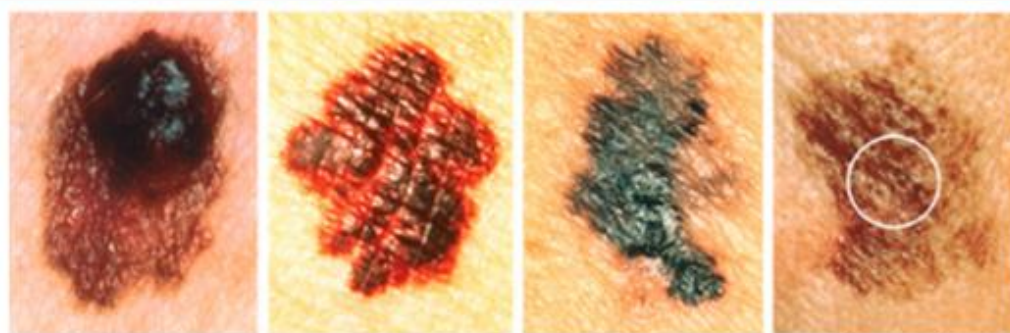
11+	Extreme
8, 9, 10	Very High
6, 7	High
3, 4, 5	Moderate
1, 2	Low

Protect Yourself in 5 Ways

- Slip on sun-protective clothing
- Slap on SPF30+ sunscreen. Reapply every two hours
- Slap on a broad-brimmed hat
- Seek shade
- Slide on wrap-around sunglasses

Sun protection is generally not needed unless outside for extended periods

Check for skin cancer:



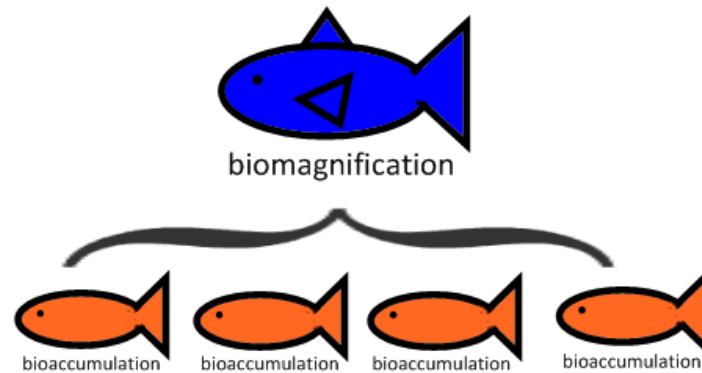
Asymmetry

Border
irregularity

Color

Diameter:
1/4 inch or
6mm

<http://64.143.176.9/library/healthguide/en-us/support/topic.asp?hwid=aa78799>



For more IB Biology resources:

<http://sciencevideos.wordpress.com>